

CLIMATE MONITORING AND DIAGNOSTICS LABORATORY

Boulder, Colorado

Mission and Purpose

The Climate Monitoring and Diagnostics Laboratory (CMDL) is the only federal laboratory whose mission is to monitor atmospheric greenhouse species that affect climate and those that cause ozone layer depletion. Long-term, continuous, precise measurements of climate forcing and ozone layer depleting species are required for climate and ozone layer projections which are delivered to customers through international assessments such as the IPCC Climate Assessments and the UNEP/WMO Ozone Assessments. These assessments provide policy-relevant information on future climate and status of the ozone layer. Linkage to the NOAA Strategic Plan is through Mission Goal 2: *Understand climate variability and change to enhance society's ability to plan and respond*. In the case of ozone and ozone-depleting gases, NOAA, along with NASA, is mandated to report to Congress on their status by the Clean Air Act of 1990. CMDL's research is linked closely to the U.S. Climate Change Science Program which has as its Mission Goal 2: *Improve the quantification of the forces bringing about changes in the Earth's climate and related systems*, which has been adopted for the NOAA Climate Program Mission Goal 2. CMDL accomplishes its mission through five Baseline Observatories and a global cooperative flask sampling network including more than 50 sites with analysis done in Boulder using CMDL-produced gas standards. Climate forcing species monitored include carbon dioxide and methane and their isotopic carbon content, nitrous oxide, the CFCs, stratospheric and tropospheric ozone, aerosols, solar radiation, and for stratospheric ozone depletion, all the chlorine- and bromine-bearing species that deplete ozone. In addition to policy-relevant information made available in assessments, CMDL uses its data (about 85% of the world's carbon dioxide data) together with data from other countries to form global greenhouse gas data bases (GlobalviewCO2 and GlobalviewCH4) available on the web and experiences 80-100 file download requests per month from government agencies, universities and private citizens in numerous countries. Recently an interactive data visualization program has been added to CMDL's web site which allows non-specialists and students to graph any of CMDL's data.

History.

CMDL was formed in 1990 from climate-related elements within the Boulder branch of the ERL Air Resources Laboratory, in particular, the Geophysical Monitoring for Climatic Change (GMCC) program and the Climate Research Division (CRD). The latter became the Climate Diagnostics Center (CDC) in 1993. Four of the Baseline Observatories (Barrow, Alaska; Mauna Loa, Hawaii; American Samoa; and South Pole Station, Antarctica), are manned sights which were established shortly after NOAA's creation in the early 1970's. A fifth observatory, currently unmanned, was established at Trinidad Head, California in 2002 in order to monitor Asian emissions incident on the west coast of the U.S. The Mauna Loa Observatory carbon dioxide record constitutes the longest continuous carbon dioxide record in the world (45 years) and is considered by many to be the most important long-term environmental record in existence, being the origin for concern about potential long-term climate change.

Financial Data (Dollars in Thousands)

Fiscal Year	Permanent Funding	Other NOAA	Non- NOAA	Pass Through	TOTAL
FY 2001	4098.3	2717.5	2287.3	0	9103.1
FY 2002	4745.2	5882.3	2293.7	0	12921.2
FY 2003	4813.7	7847.4	2039.5	0	14700.6

Personnel Data

FY	FEDERAL EMPLOYEES	JOINT INSTITUTE	Contractors	TOTAL
FY 2000	52	35	1	88
FY 2001	48	28	4	80
FY 2002	48	28	0	76
FY 2003	50	31	3	84

Average Age Federal/Scientific/Engineering and Technical Staff 46

Average Age of JI/Scientific/Engineering and Technical Staff 44

Federal Staff PhD 32% MS 6%

JI Staff PhD 34% MS 17%

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PARTNERSHIPS

PARTNERSHIPS	Identify and Explain
Joint Institutes	<p>CIRES (Univ. of Colorado): Extensive joint research and atmospheric monitoring projects are conducted at the CMDL Boulder facilities.</p> <p>CIFAR: University of Alaska cooperative research in arctic atmospheric science at the Barrow and Boulder facilities.</p> <p>CIMMS (Univ. of Oklahoma) and CIRA (Colo. State Univ.): CMDL provides large amounts of high quality data for modelers at both institutions.</p>
PARTNERSHIPS WITH OTHER NOAA LABS	<p>AOML and PMEL: CMDL conducts cooperative carbon cycle and halocarbon measurements in the marine environment along with the study of sulfur particulates in the global atmosphere with these labs.</p> <p>GFDL: CMDL cooperates in conducting Global Carbon Cycle modeling and</p>

	<p>Global Climate Model results compared to observed radiation.</p> <p>AL: CMDL and AL jointly developed three airborne gas chromatographs for aircraft and balloons and each participates in aircraft missions organized by NASA and NOAA laboratories.</p> <p>Cooperative investigations of cloud radiative properties and indirect effects of aerosols are undertaken with the AL.</p> <p>ETL: CMDL investigates the adequacy of radiation and aerosol inputs in predictive atmospheric models and cooperates in the implementation of the SEARCH program.</p> <p>ARL: CMDL operates an ARL atmospheric mercury measurement program the Barrow Observatory and ARL conducts cooperative solar radiation measurements and calibrations.</p> <p>PMEL: CMDL conducts joint aerosol chemical composition measurements and analyses with PMEL.</p>
OTHER OAR PROGRAMS	<p>Arctic Research Program Office: CMDL participated in experiments to determine emissions of important trace gases along the Siberian Railway corridor.</p> <p>CMDL is assisting in the establishment of two arctic observatories funded by NOAA through the Arctic Research Program Office.</p> <p>CMDL is conducting a retrospective analysis and expansion of the arctic climate-monitoring network.</p> <p>Office of Global Programs: CMDL conducts monitoring of radiatively important trace gases on a global scale with funding from this office.</p>
OTHER NOAA RELATIONSHIPS	<p>National Weather Service (NWS): CMDL has total-column ozone and/or solar radiation instrumentation and cooperative operations at seven NWS stations across the U.S. and UV monitoring at the NWS site in Nome and St Paul, Alaska.</p> <p>NESDIS: CMDL hosts and supports a polar satellite data downlink antenna for NESDIS at the Barrow Observatory.</p> <p>The Barrow Observatory hosts a NESDIS Climate Reference Network (CRN) site. Similar CRN instruments will be added to the Mauna Loa and Trinidad Head CMDL Baseline Station sites in FY2004.</p> <p>CMDL obtains carbon cycle flasks from the “Ships of Opportunity Program” operated by NESDIS.</p> <p>In FY04 The CMDL Carbon Cycle Observing System will be used in collaboration with satellite CO₂ retrievals.</p>
OTHER FEDERAL AGENCIES	<p>Department of Energy (DOE): CMDL hosts the ARM arctic site at the Barrow facility and operates the surface and airborne aerosol monitoring programs at the</p>

	<p>DOE Great Plains ARM site in Oklahoma.</p> <p>The Northeast Regional Center of the National Institute for Global Environmental Change (NIGEC) provides funding to both CMDL and Harvard University to monitor important trace gases at the Harvard Forest tower site, Massachusetts.</p> <p>Battelle-Northwest Laboratories: CMDL samples for Persistent Organic pollutants (POPS) in the arctic at the Barrow Observatory.</p> <p>Other DOE: CMDL is host to radionuclide collectors at all of the baseline observatories except Trinidad Head, California.</p> <p>National Aeronautics and Space Administration (NASA): CMDL is host to, and provides manpower for a NASA AGAGE site in American Samoa. It also hosts the NOAA/NASA Network for the Detection of Stratospheric Change (NDSC) facility at Mauna Loa, Hawaii and conducts NDSC measurements South Pole.</p>
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<p>OTHER FEDERAL AGENCIES - continued</p>	<p>CMDL is the co-investigator in the NASA Southern Hemisphere Additional Ozonesonde (SHADOZ) project and operates three international ozonesonde stations in the network.</p> <p>CMDL operates surface radiation sites at Kwajalein and Bermuda with NASA funding. CMDL contributes a major component to the NASA Clouds and Earth's Radiant Energy System.</p> <p>CMDL is host to the NASA AERONET sunphotometer project's primary calibration site at Mauna Loa Observatory.</p> <p>Mauna Loa Observatory hosts the National Center for Atmospheric (NCAR) Research High Altitude Observatory facilities supported by the National Science Foundation.</p> <p>CMDL and NCAR participate in extensive trace gas intercomparisons to maintain intercomparability and consistency of measurements.</p> <p>Naval Surface Warfare Center (NAVSWC): CMDL supports a Navy magnetic fields monitoring installation at the Barrow Observatory.</p> <p>United States Department of Agriculture (USDA): CMDL hosts the USDA solar radiation baseline calibration site at Mauna Loa, Hawaii.</p> <p>CMDL operates precipitation gauges at the Barrow Baseline station for the USDA.</p> <p>United States Geological Survey (USGS): The USGS Arctic Magnetic Observatory is located adjacent to the CMDL Barrow Observatory and is operated by CMDL staff.</p> <p>CMDL collaborates with the USGS Alaska Science Center and Russian National Academy in a study of arctic climate variability.</p> <p>Mauna Loa Observatory is host to a USGS seismometer and tilt and strain well to monitor local lava flows and earthquakes.</p>
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<p>OTHER FEDERAL</p>	<p>Department of Interior (Parks Service): Mauna Lao Observatory maintains two</p>
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AGENCIES -continued	<p>helicopter landing sites used by the Parks Service for patrols and facility repairs.</p> <p>Environmental Protection Agency (EPA): The EPA studies long-range transport of mercury in the atmosphere in a joint project with CMDL at Mauna Loa Observatory.</p> <p>Federal Aviation Administration (FAA): Mauna Loa Observatory is host to an FAA GPS system for controlling aircraft in the Pacific Basin.</p> <p>United States Army: Mauna Loa Observatory is host to a large command and control radio system used by the U.S. Army for the Pacific Army live fire base on the Island of Hawaii.</p> <p>CMDL operates a solar radiation facility with the U.S. Army on Kwajalein Island, Pacific Ocean.</p> <p>United States Air Force (USAF): The USAF ships helium, free of Charge, to CMDL balloon sites from a depot in Texas to any airbase in the world that is near a CMDL balloon site.</p> <p>The Air Force samples air flasks for CMDL on Ascension Island in the mid-Atlantic Ocean.</p> <p>A guest Air Force scientist at CMDL maintains and updates the MODTRAN radiative transfer code for the USAF.</p> <p>Mauna Loa Observatory hosts a USAF-supported Civil Air Patrol radio re-broadcast facility covering the State of Hawaii.</p> <p>Support is given to the BRW Observatory by the USAF Long Range Radar Site in Barrow, including snow removal and road maintenance.</p> <p>National Science Foundation (NSF): CMDL operates the NSF-owned Clean Air Facility (CAF) at the South Pole and assists in instrumenting the NSF Summit, Greenland, research facility.</p> <p>CMDL is host to a wide range of NSF-sponsored university research projects (in excess of 30) at the five CMDL Baseline stations.</p>
OTHER FEDERAL AGENCIES -continued	<p>United States Navy (USN): Mauna Loa Observatory is host to a Navy camera system for the control and monitoring of bombing in the Pohakuloa live fire range.</p>
STATE AGENCIES	<p>Hawaii State Department of Health (DOH), Honolulu: Mercury samples collected at Mauna Loa Observatory are analyzed by the DOH.</p> <p>Illinois State Water Survey, Urbana, Illinois: This agency hosts the CMDL Bondville aerosol monitoring site that has been monitoring the climate forcing properties of aerosols at that location since 1994.</p> <p>Hawaii County Police, Hawaii: Mauna Loa Observatory hosts a radio re-broadcast facility for the police and Hawaii Civil Defense radios covering all of the Island of Hawaii.</p> <p>Colorado Department of Public Health and Environment, Air Pollution Control Division: CMDL provides background values for a number of trace gases of interest</p>

	to the division.
LOCAL PARTNERSHIPS	<p>Metro Wastewater Reclamation District, Colorado: Local radiation environment</p> <p>Denver Water Board, Colorado: Local radiation environment</p> <p>AEROMET Inc, Tulsa, Oklahoma: Activities at the Kwajalein BSRN site</p> <p>Eppley Laboratory, Rhode Island: Instrument design, modification, and calibration</p> <p>Atmospheric Observing Systems, Boulder, Colorado: Sampling systems</p> <p>Bermuda Biological Station for Research, Inc.: Flask sampling</p> <p>Biospheric Instruments, Inc., California: Solar radiation instruments</p> <p>ENSI, Colorado: Ozonesondes</p> <p>Joseph Sealy, Barbados: Flask sampling</p> <p>Pinnacle Towers Inc., Texas: CO₂ sampling tower</p> <p>PIQUNIQ Management Corporation, Shemya, Alaska: Sampling</p> <p>Point Arena Lighthouse Keepers, Inc., California: Flask sampling</p> <p>Wisconsin Educational Communications Board: CO₂ sampling tower</p> <p>Atmospheric Environment Research (AER), Cambridge, Massachusetts: Airborne halocarbon data and modeling support</p> <p>ASOS, Boulder, Colorado: CO₂ monitors, airborne flask samplers</p>
LOCAL PARTNERSHIPS - continued	<p>DuPont Company, New Jersey: Halocarbon emission estimates</p> <p>M&D Consulting, Germany: Provides halocarbon emission data and uses halocarbon data to validate models</p>
UNIVERSITY PARTNERSHIPS	<p>Some universities have projects at more than one baseline observatory and some universities have a number of different projects at one observatory.</p> <p>Barrow Observatory, Alaska</p> <p>Scripps Institute of Oceanography, La Jolla: Carbon cycle gas monitoring</p> <p>University of Tokyo, Japan: Magnetic micropulsations</p> <p>University of California, Irvine: Methane flask sampling, C¹⁴ in air</p> <p>Princeton University: Oxygen in air flask sampling</p> <p>San Diego State University, California: Carbon-dioxide flux from the tundra.</p> <p>State University of New York, Albany: Thaw depth in permafrost</p> <p>University of Washington: Arctic coastal ice optical characteristics</p>

	<p>University of Alaska, Fairbanks: SuoimiNet GPS meteorology station, Institute of Arctic Biology – Arctic climate change studies, snow gauge studies</p> <p>Mauna Loa Observatory, Hawaii</p> <p>Scripps Institute of Oceanography, La Jolla: Carbon cycle gases and oxygen</p>
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UNIVERSITY PARTNERSHIPS - continued	<p>Mauna Loa Observatory, Hawaii - continued</p> <p>University of California, Davis: Aerosol chemistry</p> <p>University of Hawaii, Honolulu: Sulphate chemistry</p> <p>State University of New York, Stonybrook: Carbon monoxide and its isotopes</p> <p>California Institute of Technology: Cosmic dust fluxes</p> <p>University of Massachusetts, Amherst: Stratospheric ozone profiles</p> <p>University of California, Irvine: Trace gas sampling</p> <p>University of New Hampshire, University of Hawaii, Michigan Aerospace, and Mount Washington Observatory: GroundWinds lidar</p> <p>University of Denver: FTIR columns spectra of atmospheric gases</p> <p>Colorado State University, Fort Collins: Ultraviolet radiation project</p> <p>Central Connecticut University: Clidar aerosol lidar project</p> <p>University of Nations: Calibration of Microtops ozone meters</p> <p>Kinki University, Japan: Solar radiation instrument calibration for satellite measurements</p> <p>Meteorological Research Institute, Japan: Spectral radiation calibrations for solar radiation measurements</p> <p>University of Michigan: Atmospheric lidar measurements</p> <p>Trinidad Head Observatory, California</p> <p>Humboldt State University, California: Operation of the Trinidad Head Baseline station and weekly release of ozonesondes</p> <p>Scripps Institute of Oceanography, La Jolla, California: Joint collection of flask samples and sharing data</p>
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PARTNERSHIPS -	Samoa Observatory, American Samoa
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continued	<p>Scripps Institute of Oceanography, La Jolla: Carbon cycle gases, halocarbons, and oxygen</p> <p>University of California, Irvine: Methane flask sampling</p> <p>Princeton University: Oxygen flask sampling</p> <p>South Pole Observatory, Antarctica</p> <p>Scripps Institute of Oceanography, La Jolla: Carbon cycle gases and oxygen sampling Sampling of firn air to delineate historic trends for trace gases</p> <p>University of Arizona: Hydrogen peroxide</p> <p>University of California, San Diego: Isotopes of oxygen</p> <p>Georgia Institute of Technology: Sulphate and nitrogen chemistry reaction experiments</p> <p>University of Idaho: Radiation measurements, Dome C, Antarctica</p> <p>Niwot Ridge, Colorado, High Altitude Sampling Facility</p> <p>University of Colorado, Mountain Research Station joint research and monitoring operations at Niwot Ridge, Colorado</p> <p>CMDL Boulder, Colorado, David Skaggs Research Center</p> <p>Institute for Alpine and Arctic Research (INSTAAR): Joint carbon cycle gas isotope research program.</p>
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PARTNERSHIPS - continued	<p>Cooperative Dobson ozone total column spectrometer, surface ozone, and/or ozonesonde network</p> <p>CNRS, University of Riems, Haute Provence, France</p> <p>NIWA, Lauder, New Zealand, Bureau of Meteorology, Perth, Australia</p> <p>Meteorological and Hydrological Service, Marcapomacocha, Peru</p> <p>University of the South Pacific, Suva, Fiji</p>
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	<p>Meteorological and Hydrological Service, San Cristobal, Galapagos, Ecuador</p> <p>Bermuda Biological Station, Tudor Hill, Bermuda Tudor Hill, Bermuda, Bermuda Biological Station</p> <p>NIWA , Arrival Heights, Antarctica</p> <p>University of Alabama, Huntsville</p> <p>University of Colorado, Boulder</p> <p>Florida State University, Tallahassee</p> <p>Humboldt State, Arcata, California</p> <p>University of Alaska, Fairbanks</p> <p>Cooperative flask sampling program for carbon cycle and halocarbon gases, including aircraft sampling programs not listed under Carbon Cycle Network and Halocarbon Network Collaborations</p> <p>University of Colorado, Boulder</p> <p>University of Bristol, England</p> <p>University of Sao Paulo, Brazil</p>
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PARTNERSHIPS - continued	<p>University of Fiji</p> <p>University College, Galway, Ireland</p> <p>Harvard University, Massachusetts</p> <p>Bowdoin College, Maine</p> <p>Princeton University, New Jersey</p> <p>Carnegie Mellon University, Pennsylvania</p> <p>Other University Collaborations</p> <p>University of Illinois, Urbana-Champaign: Aerosol monitoring</p> <p>National Autonomous University of Mexico: Aerosol measurements</p> <p>University of La Laguna, Spain: Aerosol data analysis</p> <p>University of Stockholm, Sweden: Aerosol/cloud measurements</p> <p>Dalhousie University, Canada: Joint ocean trace gas research</p>
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	<p>Universitaet Frankfurt, Germany, Institut fuer Meteorologie und Geophysik: Future surface sampling site, airborne trace gas research</p> <p>University of Goteburg, Sweden: International assessment of ozone</p> <p>Utrecht University, Netherlands: International assessment of ozone, studies of atmospheric methyl chloroform, intercomparisons of trace gases</p> <p>University of New England, Maine and Bigelow, Laboratory: Joint ocean trace gas research</p> <p>Princeton University: Ice firn research</p> <p>Woods Hole Oceanographic Institution: Joint ocean trace gas research</p>
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PARTNERSHIPS - continued	Other University Collaborations - continued <p>University of Idaho: Dome Concordia (Antarctica) Satellite (AIRS) surface characteristics and temperature validations studies</p> <p>University of Washington: Study of snow-air interactions and radiation regime at Dome Concordia</p> <p>University of Alabama: Cloud detection automation</p> <p>Sinte Gleska University, South Dakota: Educational partnership</p> <p>University of California, San Diego, Scripps: ABC radiation calibrations</p> <p>University of Washington: Studies of snow surface properties in Antarctica</p> <p>Hampton University: Balloon-borne radiavtive flux measurements</p> <p>Colorado State University: IR Calibration exchange and occasional academic lectures</p> <p>University of Toronto, Canada: SEARCH and Canadian Network for Detection of Arctic Change</p> <p>Swiss Institute of Technology (ETH), Zurich: BSRN calibrations</p> <p>Eppley Laboratory, Rhode Island: Instrument design, modification, and calibration</p> <p>University of Utah: Aerosol data analysis</p> <p>National Autonomous University of Mexico: Aerosol measurements and analysis</p> <p>University of La Laguna, Spain: Aerosol data analysis</p> <p>Harvard Forest Observatory, Harvard: Carbon cycle gas measurements</p>
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INTERNATIONAL PARTNERSHIPS	CMDL operates an international cooperative flask-sampling program for carbon cycle and halocarbon gases, including aircraft sampling. The country of the measurement and the cooperating agency or individual is listed.	
	<p> Estevan Point, Canada Fortaleza, Brazil: Molokai Island, Hawaii Rarotonga, Cook Islands Santarem, Brazil Alert, Nunavut, Canada Ascension Island, Assekrem, Algeria Terceira Island, Azores, Portugal Baltic Sea, Poland St. Davids Head, Bermuda Tudor Hill, Bermuda Black Sea, Constanta, Romania Cape Grim, Tasmania, Australia Christmas Island, Kiribati Crozet Island, France Easter Island, Chile Mariana Islands, Guam Halley Station, Antarctica Hegyhatsal, Hungary Storhofdi, Iceland Tenerife, Canary Islands Sary Taukum, Kazakhstan Plateau Assy, Kazakhstan Mace Head, Ireland Sand Island, Midway Gobabeb, Namibia Ochsenkopf, Germany Pallas-Sammaltunturi, Finland Pacific Ocean, N/A Ragged Point, Barbados Mahe Island, Seychelles Shemya Island, Alaska South Pacific Ship, N/A Ocean Station M, Norway Syowa Station, Antarctica Shemya Island, Alaska Tae-ahn Peninsula, Korea </p>	<p> H.F. Schulz LBA INPE/CPTEC Hawaii Air Ambulance Air Rarotonga LTD LBA INPE/CPTEC Meteorological Service of Canada USAF Office de la Meteorologie Instituto de Meteorologia Morski Instytut Rybacki Bermuda Biological Station Bermuda Biological Station Marine Research Institute CSIRO Dive Kiribati Centre des Faibles Radioactivities Direccion Meteorologica de Chile Guam Marine Laboratory British Antarctic Survey Hungarian Meteorological Service Icelandic Meteorological Office Instituto Nacional de Meteorologia Institute of Environment Institute of Environment University College Galway U.S. Fish and Wildlife Service Desert Research Foundation Max Planck Institute Finnish Meteorological Institute Volunteer Ship Program Private Party Seychelles Bureau of Standards PIQUNIQ Management Corp. Voluntary Observing Ship Norway Meteorological Institute Institute of Polar Research PIQUNIQ Management Corp. Korea-China Centre for Atmospheric Research </p>

INTERNATIONAL PARTNERSHIPS - continued	CMDL operates an international cooperative flask-sampling program for carbon cycle and halocarbon gases, including aircraft sampling. The country of the measurement and the cooperating agency or individual is listed.	
	Tierra Del Fuego, Argentina Ulaan Uul, Mongolia Sede Boker, Israel Mt. Waliguan, China Ny-Alesund, Svalbard	Servicio Meteorologico Nacional Mongolian Hydromet Weizmann Institute of Science Chinese Academy of Meteorological Sciences Norway Meteorological Institute
OTHER INTERNATIONAL PARTNERSHIPS	CMDL has a variety of Partnerships, Cooperative Agreements and Memorandum of Understandings with agencies in other countries to conduct sampling and other measurements.	
	National Institute of Polar Research, Japan Environment Canada Meteorological Service National Academy of Sciences, Russia Roshydromet, Russia World Meteorological Organization, Switzerland World Radiation Center, Switzerland World Climate Research Program, Geneva Bureau of Meteorology, Perth, Australia	Studies of polar aerosol optical properties SEARCH, and joint research operations at Alert and Eureka Cooperation on BSRN site SEARCH, and establishment of climate monitoring station in Northern Siberia BSRN, GAW, and GCOS activities Radiometer calibration and characterization studies BSRN and GEWEX activities Operates a Dobson spectrophotometer under supervision of CMDL

OTHER INTERNATIONAL PARTNERSHIPS - continued	Czech Hydrometeorological Institute	Collaboration on calibrations of Dobson instruments
	Centre National de la Recherche Scientifique, France	Operates a Dobson spectrophotometer under supervision of CMDL and University of Reims
	Deutscher Wetterdienst, Germany	Calibrations of Dobson spectrophotometers
	Instituto Nacional de Pesquisas Espaciais (INPE), Brazil	Dobson spectrophotometer calibrations; joint WMO/GAW operations.
	National Institute of Water & Atmospheric Research, New Zealand	Operates a Dobson spectrophotometer under supervision of CMDL
	Servicio Meteorológico Nacional, Argentina	Calibrations of Dobson spectrophotometers
	Servicio Nacional de Meteorología e Hidrología del Perú	Operates Dobson spectrophotometer under supervision of CMDL
	South African Weather Bureau	Calibrations of Dobson spectrophotometers
	Max Planck Institute for Chemie, Mainz, Germany	TROICA Trans-Siberian Observations into the Chemistry of the Atmosphere
	University of Kiel, Institute für Meerskunde, Kiel, Germany	Halocarbon measurements

